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ABSTRACT

A study to identify methods most influential in determining the acceptance and use of educational innovations examined variables associated with adoption-proneness of trade and industrial teachers. Phase 1 determined predictor variables for adoption-proneness through application of multiple linear regression to personal characteristics (including Rokeach Dogmatism Scale scores) of 202 secondary vocational teachers from four school districts in Virginia. In phase 2, trade and industrial teacher scores were partitioned from the study and subjected to cluster analysis to determine which members had similar characteristics. Mean scores for adoption-proneness were calculated for each cluster, based on the identified five predictor variables from phase 1, and then examined vis-a-vis cluster profiles. Four sub-clusters were identified, based on the amount of influence members felt should be exerted by academic teachers on vocational teachers' classroom procedures. In phase 3, a survey was administered to a sample of teachers from two states for comparison purposes. Cluster analysis (1) indicated that there exist unique groups within each sample, several with similar profiles, and (2) gave additional insight into characteristics of adoption-prone teachers. Results suggest that large scale adoption of innovative practices could be enhanced by involving adoption-prone groups which, once identified, could be encouraged to lead inservice activities and use innovations. (Data analysis tables are appended.) (CP)

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ADOPTION-PRONENESS AMONG TRADE AND INDUSTRIAL TEACHERS AS MEASURED BY CLUSTER ANALYSIS[1]

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OVERVIEW

Ultimate success or failure in the implementation and use of educational innovations most often depends upon acceptance by the adoption unit or teacher. In many instances innovations or change processes are developed externally and then transmitted to the school setting, whereupon the change agent (eg. administrator, supervisor) assumes the innovation will be accepted (Fullam, 1972). As a result, many worthwhile changes and innovations fail due to lack of understanding and concern on the part of the teacher.

This study focused on determining what methods or activities might be most influential in determining the acceptance and use of educational innovations. Specific emphasis was placed on variables associated with the adoption-proneness of trade and industrial teachers.

The first phase of the study concerned testing the antecedent division of the innovation-decision process paradigm forwarded by Rogers and Shoemaker (1971, p. 103). In doing so, this phase sought to determine if various predictor variables--the personal characteristics of vocational teachers--exist in explaining a criterion variable, proneness toward the adoption of innovations. In addition, the first phase of the study attempted to determine which combination of variables tended to best predict adoption-proneness.

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The second phase of the study consisted of partitioning trade and industrial teachers from the original sample. This group was given additional consideration by performing a cluster analysis in order to determine which members of the sub-sample were most similar to each other based upon the five predictor variables found significant in the first phase of the study. Mean scores for adoption-proneness were also calculated for each cluster and then examined with respect to cluster profiles.

The third and final phase of the study involved selecting an additional sample of trade and industrial teachers from two states. Each member of this sample was asked to complete a survey instrument consisting of items found significant in phase one of the study. After tabulation of scores, a cluster analysis was performed on this sample in order to determine if cluster profiles from this group might approximate those of the original partitioned sample of trade and industrial teachers.

PHASE ONE

Methodology

The sample for the first phase of the study consisted of 202 secondary vocational teachers selected from four school districts within the state of Virginia. Teaching areas represented agriculture, business and office, distributive, health occupations, home economics, trade and industrial education, and industrial arts education.

In this phase of the study, 19 independent variables (personal characteristics of the above teachers) were examined for their predictive quality in explaining the dependent variable (score on an adoption-proneness inventory). Validity and reliability data for the inventory are provided elsewhere (Oscarson, 1977). Independent variables included teacher age, number of years

in teaching, level of educational achievement, recency of professional education, professional publications read on a monthly basis, membership in professional organizations, cosmopolitanism, number of years teaching in the present school district, score on the short form of the Rokeach Dogmatism Scale, predisposition toward changing teaching methods, personal satisfaction with teaching, the actual influence a teacher felt was exerted on instructional procedures by four sources, and the ideal influence a teacher felt should be exerted on classroom procedures by the four sources. "Dummy" variables included membership in a particular school district and the seven teaching areas.

Multiple Linear Regression

The maximum R^2 improvement developed by Goodnight (1972) was the multiple linear regression technique selected to determine significant prediction variables for this phase of the study. In describing this technique, Goodnight considered it superior to the step-wise technique in that it determines the "best" one variable model, the "best" two variable model, and so forth while yielding the greatest increase in R^2.

In order to select the best regression equation, three basic criteria were utilized as limiting factors. The first criterion called for the final regression model to possess an F ratio significant at the .01 level or lower. A second criterion established that no model would be considered unless it demonstrated an increase of at least .01 in the coefficient of determination (R^2) over a previous equation. The third and final criterion established that any variable included in the model must itself be significant at the .10 level or lower.

Employing the preceding criteria the final regression model included five predictor variables which consisted of: (1) Whether a teacher found teaching personally satisfying, (2) Number of professional publications read on a monthly basis, (3) teacher age, (4) The ideal influence a teacher felt should be exerted on instructional procedures by academic teachers, and (5) The number of years spent teaching in the present school district.

The (b) values for each of the first four variables were positive, indicating that there was a positive relationship with the criterion variable (adoption-proneness). The fifth variable (years teaching in the present school district) possessed a negative (b) value, indicating that teachers who had remained in their present school district for a substantial time tended to score lower on the adoption-proneness inventory (criterion variable). Table 1 presents the final regression model and relative statistics for the five predictor variables.

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insert Table 1 about here

PHASES TWO AND THREE

Cluster Analysis

Johnson (1967) has described cluster analysis as a technique for partitioning objects into homogeneous groups on the basis that the objects possess empirical measures of similarity. The similarity of objects, in this case, individuals, can be determined by their resembalance to one another over a set of variables such as the predictor variables found significant in phase one of this study. This technique has proved useful in the fields of medicine and biology, where objects have represented human or animal subjects. As a result, cluster analysis was selected for this study.

Green and Tull (1970) have delinated the clustering procedure as using pairwise measures of proximity. By employing the notion of Euclidean distance, a great number of proximity measures can be viewed as distance in metric space. The following formula described by Green and Tull (1970, p. 437) represents the distance between two points in space along (r) dimensions.

$$d_{ij} = \left[\sum_{K=1}^{r} (X_{ik} - X_{jk})^2 \right]^{1/2}$$

Where

X_{ik}, X_{jk} are the projections of points i and j on dimension K (k=1,2,. . .,r)

For this study, some of the variables were measured in different units; therefore the above formula was applied in phases two and three after each variable had been standardized with a mean of zero and unit standard deviation. In order to clarify this point, variables with a pre-selected range of possible values are as follows: Variable 1 sought to determine the ideal influence the vocational teacher felt should be exerted on classroom procedures by the academic teacher. A respondent's score could range from 1 (little or no influence) to 6 (a very great deal of influence). The score for Variable 2 was determined by a single response to Likert scaled item which asked the respondent to indicate the degree of agreement or disagreement he or she felt toward finding teaching personally satisfying. A score of 1 indicated a respondent did not find teaching satisfying, while a score of 6 indicated a very high degree of satisfaction. Finally, scores for Variable 6, the adoption-proneness inventory, could have ranged for a low of 17 (no proneness toward adoption of innovations) to a high score of 119.

With regard to the preceding discussion, cluster analysis for this study was concerned with

1. a description of individuals rather than inference.
2. relationships among the predictor variables.
3. an intuitive description of each cluster.

The following section serves to describe results of the cluster analysis performed on the samples utilized in phases two and three of this study.

Results

After the five significant predictor variables were established in the first phase of the study, a cluster analysis was performed on the partitioned

sample of trade and industrial teachers (n=33) by utilizing a sub-routine of the Statistical Analysis System (SAS) developed by the Institute of Statistics at North Carolina State University. This package provides statistics for maximum, average, and minimum distances within and between clusters, a cluster map examining membership in each cluster, and a cluster listing that identifies membership of each cluster and those subjects' scores for each variable.

Results of the analysis indicated that, based on the five predictor variables, the partitioned sample of trade and industrial teachers could be optimally divided into four distinct groups. Attempts to form additional clusters tended to produce results that could not be easily explained. Table 2 provides a summary of the cluster analysis.

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insert Table 2 about here

Cluster 1 (n=8) identified teachers who felt that the ideal influence exerted by academic teachers on a vocational teacher's classroom procedures should be rather strong. Based on their mean standardized score (1.38) for this variable, the group could easily be distinguished from the remaining three clusters. With respect to the other variables, this group did not deviate substantially for the baseline mean of zero. The average score on the adoption-proneness inventory (84.6) proved to be somewhat low and did not distinguish this group.

Cluster 2 (n=11) tended to be composed of younger trade and industrial teachers and as a result had served for a substantial amount of teaching time in their present school district. With respect to the other variables, they were less satisfied with teaching than their older counterparts, felt academic teachers should have minimal influence on classroom procedures,

yet scored somewhat higher on their average score for the adoption-proneness inventory. This group did tend to read more monthly publications than the two remaining clusters.

Cluster 3 (n=9) tended to be the most adoption-prone of all the groups in that their average score (91.3) for the adoption-proneness inventory was the highest. This group most nearly approximated results from phase one of the study as they were older, read a substantially greater number of journals, had not spent a substantial amount of time in their present school district, and were highly satisfied with teaching. Unlike the composite sample, they did tend to feel that ideally the academic teacher should have little influence on a vocational teacher's classroom procedures.

Cluster 4 (n=5) was composed of older trade and industrial teachers, yet unlike their counterparts in Cluster 3, they tended to be diametrically opposed with respect to scores for the remaining variables. This was demonstrated by their aversion to reading monthly publications, low level of satisfaction with teaching, and low scores for the variable relating to ideal academic teacher influence on classroom procedures. In addition, this group had the lowest mean scores on the adoption-proneness inventory.

To provide further insight about clustering patterns, an additional sample of trade and industrial teachers (n=45) was selected from the states of Virginia and Kansas at a later date. Since phase one established the significant criterion variables, this sample was asked to complete only items that related to the five significant criterion variables plus the adoption-proneness inventory.

Results of the cluster analysis indicated that this sample could also be clustered into four groups, An additional "cluster" consisted of one

individual and by the nature of his responses this person was considered to be an outlier. Table 3 provides a summary of the cluster analysis for this group.

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insert Table 3 about here

Cluster 1 (n=8) possessed the highest mean score on the adoption-proneness inventory (94.6). This group closely approximated the profile for cluster 3 in phase two of the study in that they felt academic teachers should have minimal influence on a vocational teacher's classroom procedures, were highly satisfied with teaching, had not spent many years in their present school district, were quite well read, and were on the average older than teachers from other clusters.

Cluster 2 (n=3) possessed the second lowest mean score on the adoption-proneness inventory and their profile resembled that of cluster 4 in phase two of the study. This group was comprised of older trade and industrial teachers who had spent a considerable number of years teaching in their present school districts. They scored slightly below the mean on the item relating to satisfaction with teaching and the variable relating to ideal academic teacher influence. This group did differ from cluster 4 in phase two in that they appeared to be more satisfied with teaching and did read considerably more publications. Since the membership in this group was quite small, the above responses remain open to further speculation.

Cluster 3 (n=12) approximated the profile for Cluster 2 in phase two along four of the six dimensions. Similarities existed in that they were quite young, scored near the standardized mean in professional publications read, and had not spent many years teaching in their present school districts. Average scores on the adoption-proneness inventory for each cluster were quite close (88.4 vs 87.6) and, in each case, this represented the second highest score in each phase of the study.

Cluster 4 (n=21) had the highest membership and appeared to be rather unique when considering the cluster listings of phase two. Overall, this group tended to be comprised of teachers who were ranked above the standardized mean regarding age, were below the mean on publications read on a montly basis, ranked near the mean with respect to years in the present school district, and showed below average satisfaction with teaching. This group also had the lowest average score on the adoption-proneness inventory.

"Cluster" 5 (n=1) could not really be considered a cluster, but was included to demonstrate the strength of using the clustering subroutine. As table 3 depicts, this individual was singled out due to deviant scores regarding items that related to age, ideal academic teacher influence, and exceptionally low satisfaction with teaching.

DISCUSSION

Overall, cluster analysis results for the samples from phases one and two indicated that there existed unique groups within each sample and that several of the clusters from each sample has similiar profiles. While not providing identical results, phase three did provide an additional notion of validity to the overall study in that clusters formed during phase three of the analysis possessed profiles similiar to those clusters formed in phase two. Another strength of utilizing the clustering technique is that many of these groups would be overlooked if phase one results were considered alone. Cluster analysis for each sample provided additional insight into the characteristics of adoption-prone trade and industrial teachers and their counterparts who did not score highly on the inventory.

Cluster analysis provided the distinct advantage of analyzing individual teachers rather than solely identifying generalized traits for the entire population. In addition, the analysis demonstrates that unique groups exist within subsamples of trade and industrial teachers in each of the latter two phases of the study that would have been overlooked in the first phase. Results of this study appear to suggest that large scale adoption of innovative practices across school districts or an entire state could be enhanced by involving groups (eg. trade and industrial teachers) that demonstrate adoption-proneness such as have been determined in this study. Therefore, those responsible for the diffusion of innovative concepts and ideas should seek to identify groups similar to those determined in the cluster analysis to lead inservice activities or be the first to utilize innovations. Application of the preceeding results would assist in reducing time, costs, and expended energy for those responsible with acquiring acceptance of educational innovations.

Table 1

Regression Analysis Between
Five Independent Variables[a] and the
Dependent Variable Adoption-proneness

Source	df	Mean square	F Value	R-square
Regression	5	1002.77	10.76**	0.22
Error	190	93.13		
Source	df	B values	F Value	
Mean	1	55.71		
Satisfaction	1	3.21	28.59**	
Publication	1	1.27	15.85	
Age	1	0.21	3.34	
Ideal Academic Teacher Influence	1	1.26	2.94	
Years in teaching in present district	1	0.24	3.08	

[a]Satisfaction, Age, Publications, Ideal Academic Teacher Influence, Years Teaching in Present School District.

**p < .01.

Table 2

Mean Scores for Cluster Listing-Phase Two

	n	Standardized Mean Scores					
		Age	Publications Read Monthly	Years in District	Satisfaction	Academic Teacher Influence	Adoption-Proneness Score
Cluster 1	8	-0.21	-0.17	0.09	-0.19	1.38	84.62
Cluster 2	11	-0.92	0.27	-0.65	-0.49	-0.39	87.64
Cluster 3	9	0.81	0.45	0.05	1.20	-0.37	91.33
Cluster 4	5	0.90	-1.14	1.18	-0.78	-0.68	79.00

Table 3

Mean Scores for Cluster Listing-Phase Three

	n	Standardized Mean Scores					
		Age	Publications Read Monthly	Years In District	Satisfaction	Academic Teacher Influence	Adoption-Proneness Score
Cluster 1	8	0.65	1.10	-0.43	0.92	-0.75	94.62
Cluster 2	3	0.52	0.94	2.64	-0.04	-0.34	83.33
Cluster 3	12	-1.06	-0.10	-0.58	0.44	0.67	88.42
Cluster 4	4	0.36	-0.48	0.14	-0.41	0.01	79.76
Cluster 5	1	-1.53	-0.33	-0.47	-3.88	-1.15	94.00

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